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Studies on Quality and Shelf Life of Fruit Bar (Fruitamine) Developed from Papaya and Tomato

Ritika Johari

Research Scholar, Agriculture Department, AMU Aligarh

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ABSTRACT

Using tomato and papaya pulp as the base, a new product called a fruit bar was developed. The pulp of tomato and pulp was incorporated with hydrocolloids [pectin (P), starch (S), and agar (A)], along with citric acid sugar and benzoic acid. Investigations was carried out to determine the product's quality and shelf life. The TSS, acidity, Browning index (OD), and Vitamin C were among the physico-chemical properties. Sensory characteristics included attributes like aroma, taste, colour, texture, and general acceptability. A texture analysis using a Warner Bratzler Guillotine knife was carried out to determine the product's level of hardness or tenderness. It was also noted how hydrocolloids affected the textural qualities of both fresh and two-month stored products. It was found that mixed pulp was rich in nutrition with a carbohydrate content of 6.1%, a fibre content of 0.82%, a fat content of 0.123%, and a protein content of 0.67%. Different sample of fruit bar samples had moisture contents between 26.3%-28.8%, TSS between 72-72.8 °Bx, pH between 4.30 and 4.65, browning indices between 0.137 and 0.177, and 35.1-40.8 mg of vitamin C per 100g. sensory properties evaluated by a group of expert panelists on hedonic scale indicated all 12 samples were good in colour, aroma, taste. The sample $R_2r_2h_3$ had the highest hardness, whereas the sample $R_2r_2h_3$ had the lowest hardness (positive peak force was found to be 1240.7g) (positive peak force was 560.9g). From the study of ambient storage, it may found that decrease in moisture content of the product packaged in LDPE bags throughout April and May noticed to be over 2%

INTRODUCTION

India is the world's fourth-largest producer of papaya. In India, papaya is the most significant tropical fruit. The papaya is a colorful fruit. The papaya fruit is actually regarded as a berry. Papaya is only grown in 10 countries worldwide. Papaya production is dominated by India, with Brazil, Indonesia, Nigeria, and Mexico following. Only 0.1% of the world's papayas are produced in the United States. US is the biggest importer in the world. In 2019, total of 6.05 million metric tons of papaya are thought to have been produced in India. Fruit output is expected to be 6 million tons annually throughout the world. India mostly exports papaya to Bahrain, Kuwait, Qatar, Saudi Arabia, the United Arab Emirates, and other countries. Due to its excellent nutritional and therapeutic value, papaya is a fruit with significant commercial relevance. Vitamins like riboflavin, folate, thiamine, niacin, C, and A, as well as minerals like calcium, iron, and potassium and dietary fibre, are all abundant in papaya. Compared to other fruits, papaya has a higher amount of -carotene.

The fruit often has a spherical to cylindrical shape, measures 75mm to 500 mm (3 to 20 inches), or even longer, and occasionally weighs up to 9 kg to 11.5 kg (20 to 25.5 pounds). As papayas produce higher yields and grow more quickly, they come in a wide variety. Papaya has a lot of potential for blending with other fruits and can be utilized to generate commercially viable products that are economically viable.

Due to papaya's moderate flavour, other strong flavors can be added to the items to create custom sensory products. In addition to being consumed as fresh fruits, papaya has been used to make a variety of processed food products, including puree, jam, jelly, pickles, candied fruit, mixed beverages, and commercially available canned slices and chunks. The papaya fruit's pectin content, for example, has useful properties that make it suitable for jam preparation. The biochemical components of fruits have been linked to health benefits like lowering cholesterol and enabling the production of a wide range of processed products. From papaya processing, a variety of products can be made, including jam, jelly, nectar, puree, concentrate slab, toffee, tutti-fruity, freeze-dried chunks, dried rolls, dried slices, and pickles. When fresh papaya is not accessible, the processed fruit is frequently employed in military nutrition and to some extent in metropolitan areas. Table 1.1 lists the ingredients and nutritional value of ripe papaya fruit.

Table-1.1 Nutritional value of papaya per 100g of fruit

MAJOR FOOD CONSTITUENTS		
Food constituents	Value	Energy
Water	88.83 g	163 KJ/39Kcal
Carbohydrates	9.81g	
Protein	0.61g	
Fat	0.14 g	
Dietary fiber	1.8 g	

REVIEW OF LITERATURE

Ingredients affects the flavor of fruit bars. In the production of Limonia acidissima fruit bar, high methoxylated pectin induced an undesirable modification of typical flavor and intensity of flavor and taste, whereas low methoxylated pectin induced few alterations (Vidhya and Narain, 2010), while from the study of guava bar fabrication organoleptic quality (i.e., color, flavor, taste, texture, and overall acceptability) of leather decreased gradually with increase in the quantity of sugar added Jain and Nema 2007). Sugars were found also responsible of some color characteristics of fruit bars. The reducing sugars from honey or other ingredients like greater ripeness fruits would lead to the nonenzymatic Maillard browning reaction and caramelization at an elevated temperature, which explains the variations in color detected in the fruit bar base (Gamlath, 2008; Sun–Waterhouse et al., 2010).

Papaya has been known as a food or as a quasi-drug. It has wide consumption owing to its pharmacological properties (Jurandi et al.,2011) and can be used as a folk remedy for various disorders. It contains different kinds of immuno-stimulating agents and antioxidants, its pulp is utilized in hospitals of Africa for wounds healing as well as curing burns (Starley et al., 1999) because management of chronic non-healing ulcers poses difficulty and many clinical problems.
According to Reed, papaya latex is very useful for curing dyspepsia and is externally applied to burns and scalds; it also cures diarrhea, bleeding hemorrhoids, and whooping cough. Papaya juice helps in alleviating infections of the colon by clearing away infection, pus, and mucus. Its ripe fruit is a carminative, diuretic, expectorant, sedative, and has preventive action against dysentery, skin diseases, psoriasis, and ringworm. Papaya also exhibits therapeutic assets against various pathological disorders. The unripe fruit is used as a remedy for ulcers and impotence (Elizabeth et al., 1994); it has the ability to exhibit bacteriostatic activity against human enteric pathogens (Osato et al., 1993); and it aids in reducing menstrual irregularities and promotes natural menstruation flow in women. It has been suggested for regulatory the most global problem of hair dandruff. Papaya fruit is thought to contain some immunostimulant and antioxidant agents (Starley et al., 1999); its juice is agreed to cure gastrointestinal maladies.

MATERIALS AND METHODS

Experimental Plan - These experiments were carried out to prepare the fruit bar product and to determine the quality and storage stability. For fresh samples and those that had been stored for each two months. The quality measuring parameters were physicochemical and sensory properties such as moisture content, acidity, TSS, browning index and aroma, colour, texture and overall acceptability. For both fresh and preserved samples of fruit bars, comparative effects of various hydrocolloids on textural qualities were determined.

Experimental Set-Up- In the present investigation involved several experimental setups and instruments were used. An electronic balance for weighing, a moisture analyzer, a pH meter, a hand peeler, a digital spectrophotometer, a refractometer, a grinder, and a texture analyzer. Entire the experimental work was carried out in well-established of Department of Post-Harvest Engineering and Technology, Faculty of Agricultural Sciences, A.M.U. Aligarh.

Hot Air Oven - The hot air oven (plate 3.2) has a walled chamber of 78cm×72×116cm. outer chamber is made of mild steel while the inner chamber is made of aluminum/stainless steel with 65mm glass wool insulation between two walls. Heating elements are placed in ribs of the bottom side for uniform heating. Air ventilation is fitted at the top. A thermometer is provided at the front of the oven and the thermometer controls temperature. Perforated shelves are also provided to put samples over there.

Digital Spectrophotometer - For the purpose of calculating the browning index of fruit bar samples, a portable digital spectrophotometer (plate 3.3) was employed. It was applied to the spectrophotometric analysis of any concentration of solution. The output's optical density was recorded (OD). This approach is distinctive because it blends practicality with analytical accuracy and precision. It generates a linear spectrum using a diffraction grating as the monochromatic element. With a high resolution of 600 lines per millimeter, the grating ensured a smaller bandwidth. A built-in automated shutter ensures that light only enters the test tube holding the sample when it is put into the housing, extending the life of the photodetector. The equipment has a 5 mm resolution and operates in the 340-960 nm wavelength range. For the quantitative analysis of a liquid solution, it was incredibly helpful.

Texture Analyzer -An instrument called a texture analyzer (plate 3.1) is used to evaluate the textural characteristics of food ingredients. Food materials' textural qualities vary depending on the type of product. Every food product has unique textural characteristics that are used to assess the textural quality of the product. Textural characteristics are displayed using metrics, such as crispness in the case of biscuits, spreadability in the case of jam, and bloom strength in the case of tomato ketchup. Stable Micro System, England provided the textural analyzer system. It is a textural analyzer of the HD type, and it has load cells with various capacities and the ability to put various probe attachments in its crosshead for product testing. Warner Bratzer blade of a Guillotine knife was employed as a probe in the case of the fruit bar product. A fixture with grooves is fastened to the base. Through a computer, this texture analyzer is automated.

Texture Expert - It is a computerized texture analyzer package with three key features: opening new files, choosing TA settings, and running tests. When the test is run, a force vs. time and force vs. distance graph is produced. In order to measure the textural qualities of food, such as bloom strength, cohesion, chewiness, creep, crispness, facturability, cohesiveness, adhesiveness, springiness, gumminess, relaxation, strain, extensibility, hardness, and elasticity, two types of forces, compression and extension, are used in various tests.

Ripe Papaya and Tomato

Washing

Peeling and cutting

Pulping

Homogenization pulp

Heating to 80-850C

Adding of sugar

Concentrating 720 brix

Addition of citric acid

Spread down in trays with oil coated poly film

Storage in dry place at 28-320C

Packaging

Fig. 3.1 Process flow diagram for the preparation of fruit bar

Measurement of Phsico-Chemical properties of the products

- **Moisture content determination-** Moisture of fresh fruit bar sample was determined by using the standard hot air oven method as recommended by Ranganna (1994).
  10 gm of sample was taken and uniformly spared over the dish and its weight was recorded as initial weight of sample m0. After spreading in dish, the weight was recorded as m1. Weighing was done as quickly as possible to avoid loss of moisture. The dish containing sample was placed in a hot air oven maintained at 70±0.5°C. The cover of dish was removed before placing the dish in hot air oven. After 16-18 hrs. of drying, dish was taken out of the oven, covered with its lid and put in to desiccator. The dish was cooled to the room temperature, which in general took 1 hour and was weighted. This weight was recorded as m2.
- **Total soluble solids (TSS)-**TSS measurement of fresh fruit bar sample was done with the help of a hand refractometer of high range by using the method as recommended by Shrivastava and Kumar (1994). A drop of sample was placed over the prism and the observation was done in front of light. The scale visible showed a dark line indicating TSS in degree brix.
- **pH Measurement-**The pH measurement was done by digital pH meter (Khera co.) The electrode of the pH meter was standardized with the help of known pH solution having pH 4.0 and another pH 7.0 finally the electrode was dipped in the sample of fresh fruit bar product samples and pH was recorded directly.
- **Acidity Percentage-** A fruit bar sample's acidity was determined by using the Ranganna (1994). The sample was made by combining pulp from the pulper with a measured amount of water and boiling it for one hour. It was then filtered, cooled, and transferred to a volume matric flask where the volume was then adjusted. The sample was titrated with 0.1 N NaOH using a few drops of phenolphthalein solutions as an indicator.
- **Determination of Browning Index-** Browning index of fruit bar samples was determined by using procedure as recommended by Srivastava and Kumar (1994). A beaker containing 1 gm of the sample was filled with 20 ml of 60 percent ethyl alcohol. The material was soaked in a beaker for 12 hours before being filtered with Whatman filter paper and chilled. The optical density of the filtrate at 440 nm was then measured using a blank of 60 percent ethyl alcohol by spectrophotometer, and the value recorded provides the sample's Browning index.
- **Determination of Ascorbic Acid (Vitamin-C)**
  3% Metaphosphoric acid solution - HPO3 was dissolved in distilled water in a glass to create the solution.
  Standard ascorbic acid solution- 100 mg L-ascorbic acids was weighted and made up to100 ml with 3% HPO3. 10ml was diluted to 100 ml with 3% HPO3. (1 ml = 0.1 mg of ascorbic acid).
  Dye solution- 50 mg of 2, 6 dichlorophenol indophenol was dissolved in approximately 150 mil of hot glass distilled water containing 42 mg of sodium bicarbonate, cooled and diluted with glass distilled water to 200 ml. it was stored in refrigerator and standardized daily.

Evaluation of organoleptic/ sensory characteristics

The product's sensory qualities, including colour, odor, taste, texture, and general acceptability as a fruit bar, were evaluated as recommended by Ranganna (1994). Hedonic rating test was used for evaluation. This test is used to measure the acceptability of the consumer for food products. Detailed methodology is described below.

A trained panel consisting of 10 experts or judges of different age group having different eating habits was constituted to evaluate the quality through properly planned experiments. The panelists were selected from the staff and students of Faculty of Agricultural Sciences.Samples were served to the panelist and they were asked to rate the acceptability of the product through sense of organs. Different attributes viz., colour, taste, texture, overall acceptability were rated on the basis of the 9 points of the hedonic scale ranging from 1(extremely dislike/ most undesirable) to 9 (extremely like/ most desirable). A test performance Table was also prepared and supplied to them at the time of evaluation.

Table- Scale for hedonic rating test

Rating	Score
Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like not dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

Analysis of the physicochemical properties of fruit bars

The moisture content, pH, percent acidity, TSS, browning index, and vitamin C availability in mg/100g of fruit bar made from blended papaya and tomato pulp were evaluated. The papaya and tomato were included in the blended pulps in the ratios of 75:25 and 70:30, respectively. Pectin, Starch, and Agar, three hydrocolloids, were also added to the mixture to increase its ability to bind water and create a pleasing texture. The findings of 12 samples made using different combinations of hydrocolloids in variable quantities are shown in the table. The TSS was between 74-75 degree brix, and the combined pulp had extremely low acidity, ranging from 0.077 percent to 0.099 percent, but was high in carbohydrates, minerals, and vitamin C.

The final product contained 37.6 to 41.2 mg of vitamin C per 100g. The pH of these samples showed no noticeable changes. 4.0 to 4.29 was the pH range. While the physical and chemical characteristics of these samples were nearly identical, the sample made from mixed pulp in the ratio 75:25 was determined to have the highest vitamin-C concentration. After prepared of the fruit bar product.

Analysis of the Sensory properties of fruit bars

A significant increase in the texture of the fruit bar was made by the addition of hydrocolloids. Pectin, starch, and agar were employed in combination as hydrocolloids taking two or three of them at a time and the influence of hydrocolloids on sensory characteristics were first noticed in fruit bars prepared from mixed pulp bin at the ratio 75:25.

In different percentages (0.5 % and 1.0 % each), two hydrocolloids were combined. Pectin, starch, and agar were each taken as 1.0 percent of one of the hydrocolloids. The colour, aroma, taste, and texture of 6 samples of the fruit bar were found to be excellent. P+S was found to have the best texture and test results in the samples R1r2h1, which included 1.0 percent of each (score values for taste and texture were 7.20 and 6.18 respectively). This demonstrated that the P+S combination was ineffective for creating the fruit bar's textural characteristics. The score value for P+A in the ratio of in the ratio (1.0% each) shows that the colour scores was better. Compared to the other samples, the fruit bar sample R1r2h1 with P+S (1.0 % each) had a better aroma and received a higher score (7.20).

Next, samples made from pulp that had been combined in a 70:30 ratio were collected for analysis. The effect of hydrocolloids was also seen in similar functions, and it was found that the sample R1r1h3 containing hydrocolloids P+S (1.0% each) was more suited for the development of textural qualities. The taste of sample was superior and the score value for taste was 7.20 out of 10.

CONCLUSION

Studies were conducted for development quality, evaluation and shelf life. Further the studies of fruit bar under ambient temperature, the effect of hydrocolloids was conducted on physicochemical, textural, and sensory properties of the product. Following is overview of the findings and inferences made from the study-

1) It was found that mixed pulp is a good source of protein, vitamin C, fibre, carbohydrates, and minerals and hence to a nutrient-rich food. When papaya and tomato pulp were combined in the ratio 75:25, the percentages of carbohydrates, minerals, protein and fibre were found to be 6.1, 0,725, 0.82, and 0.67%, and vitamin-C was 40.40 mg/100g, respectively.
1) Fruit bar prepared were evaluated for physicochemical characteristics like moisture content, pH, acidity, browning index, and vitamin-C mg/100g. Chemical analysis showed the moisture content ranged between 26.3-28.9, browning index ranged between 0.137-0.177 and vitamin-C ranged between 35.1-40.8 mg/100g. There was no considerable variation in TSS, acidity, pH of all 12 samples of fruit bar prepared using different combination of hydrocolloids and varying ratio of papaya and tomato pulp (75:25, 70:30 respectively).
2) The smoothness of the fruit bar was considerably improved by the addition of hydrocolloids. All of the fruit bar samples had good colour, flavour, and aroma. Each of the two distinct ratios of pectin and starch, 0.5 and 1.0%, were taken. In comparison to other combinations, sample P+S had the better colour because it had 1.0% of each.
3) Results of the texture analysis showed that sample having the pulp ratio is 70:30 with P+S (0.5% each) had the least hardness (positive peak force was 585.5g), whereas sample having the pulp ratio is 70:30 with A+P (1.0% each) had the maximum hardness (positive peak force was found to be 1203.1g).
4) It was from the study of a fruit bar under ambient condition found that samples moisture content decreased by about two percentage during being stored. The storage study was carried out in the months of April and May 2022, probably loss of the moisture was due to the excessive heat during summer and the LDPE's permeability to water vapor.

5) It was found that there was increment in TSS due to loss of moisture during two months of storage study.
6) It was found that there was increment in Browning index (OD) due to loss of moisture during two months of storage study.
7) It was observed that the pleasant taste of fresh fruit bar nearly maintained during storage.
8) It was found that the sample having the pulp ratio is 70:30 and incorporation of combined hydrocolloids (P+S) 1% each had least hardness as (positive peak force was 500.9g), whereas the sample having the pulp ratio is 75:25 and incorporation of combined hydrocolloids (S+A) 1% each had the maximum hardness (positive peak force was 1806.0g). It was observed that there was considerable improvement in textural properties of the sample during ambient temperature storage. The sample was found to be smoother in texture, more compact and better wholesomeness.
9) The sample having the pulp ratio is 70:30 and incorporation of combined hydrocolloids (P+S) 0.5% each was found to be more compact as compared to sample having the pulp ratio is 70:30 and incorporation of combined hydrocolloids (A+P) 0.5% each and good in taste after under the storage. In order to maintain the product quality during storage, samples having the pulp ratio is 75:25 and incorporation of combined hydrocolloids (P+S) 0.5% each, samples having the pulp ratio is 75:25 and incorporation of combined hydrocolloids (P+S) 1.0% each, samples having the pulp ratio is 70:30 and incorporation of combined hydrocolloids (P+S) 0.5% each, were palatable and all 12 samples, were practically found to be best in taste and texture.

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